

Claims

1. Process for purifying a composition comprising (meth)acrylic acid, at least one impurity and water, wherein the composition has a water content in the range of 0.55 to 90, based on the composition, to form a purified phase comprising (meth)acrylic acid and at least one impurity, wherein, in the purified phase, the quantity of at least one impurity is less than 7% by weight, based on (meth)acrylic acid in the purified phase, comprising a stage of the process which includes the following process steps:
- a) (meth)acrylic acid is crystallised from the composition while forming a suspension comprising a mother liquor and (meth)acrylic acid crystals;
- b) (meth)acrylic acid crystals are separated from the mother liquor;
- c) at least a portion of the separated (meth)acrylic acid crystals is melted to form a melt; and
- d) a portion of the melt is recycled to step a) or step b) and wherein the portion of melt which is not recycled is in the form of a separated (meth)acrylic acid.
2. Process according to claim 1, wherein, in step a), (meth)acrylic acid crystallises at least in part to form a crystal with a crystal structure having a surface with at least one recess located on the surface, the crystal structure having an orthorhombic Bravais crystal lattice with an Ibam space group, crystallographic data $a = 9.952 \text{ \AA}$, $b = 11.767 \text{ \AA}$ and $c = 6.206 \text{ \AA}$.
3. Process according to either of claims 1 or 2, wherein, in step a), the mother liquor comprises at least 60% by weight of (meth)acrylic acid and water, wherein the water concentration of the mother liquor is in the range of 10 and 90% by weight.

4. Process according to any of the preceding claims, wherein the (meth)acrylic acid crystals are washed in the countercurrent of the recycled melt.
5. Process according to any of the preceding claims, wherein the melt is purified in a separate purification process.
6. Process according to any of the preceding claims, wherein the (meth)acrylic acid crystals from step b) are supplied at least in part to step a).
7. Process according to any of the preceding claims, wherein the mother liquor separated in step b) is recycled at least in part to step a).
8. Process according to any of the preceding claims, wherein the process comprises at least two stages, which each comprise steps a) to d), wherein at least one of the following features ($\alpha 1$) to ($\alpha 4$) is fulfilled:
- ($\alpha 1$) separated (meth)acrylic acid from a first stage of the process is supplied at least in part to a second stage of the process;
- ($\alpha 2$) separated (meth)acrylic acid from a second stage of the process is supplied at least in part to a first stage of the process;
- ($\alpha 3$) mother liquor from a first stage of the process is supplied at least in part to a second stage of the process;
- ($\alpha 4$) mother liquor from a second stage of the process is supplied at least in part to a first stage of the process.
9. Apparatus for producing (meth)acrylic acid comprising, as components which are connected to one another in a fluid-conveying manner, a (meth)acrylic acid synthesis unit comprising a (meth)acrylic acid reactor and a quench absorber,

and a purification apparatus which comprises an apparatus unit comprising features (δ1) to (δ4):

5 (δ1) the apparatus unit comprises a crystallisation region, a separating region, a melter and at least three guides;

(δ2) the crystallisation region is connected to the separating region by a first guide;

10 (δ3) the separating region is connected to the melter by a second guide;

(δ4) the melter is connected to the crystallisation region by a third guide or to the separating region by a fourth guide;

15 wherein the purification apparatus comprises an inlet which guides a composition comprising (meth)acrylic acid, at least one impurity and water, the composition having a water content in the range of 0.55 to 90, preferably of 7 to 50 and particularly preferably of 10 to 25 % by weight, based on the composition.

20 10. Apparatus according to claim 9, wherein the (meth)acrylic acid synthesis unit and the purification apparatus are connected to one another without a distillation apparatus.

25 11. Apparatus according to either of claims 9 or 10, wherein the apparatus unit comprises a separate purification apparatus.

30 12. Apparatus according to any of claims 9 to 11, wherein the separating region is connected to the crystallisation region by a first return for separated (meth)acrylic acid.

13. Apparatus according to any of claims 9 to 12, wherein the separating region is connected to the crystallisation region by a second return for separated mother liquor.
- 5 14. Apparatus according to any of claims 9 to 13, characterised by at least two apparatus units according to features ($\delta 1$) to ($\delta 4$), which are connected by at least one connecting line, the connecting line being a feed line or a return line and at least one of the following features ($\epsilon 1$) to ($\epsilon 4$) being fulfilled:
- 10 ($\epsilon 1$) the separating region of a first apparatus unit is connected via the connecting line to the crystallisation region of a second apparatus unit;
- ($\epsilon 2$) the melter of a first apparatus unit is connected via the connecting line to the crystallisation region of a second apparatus unit;
- 15 ($\epsilon 3$) the separating region of a second apparatus unit is connected via the connecting line to the crystallisation region of a first apparatus unit;
- ($\epsilon 4$) the melter of a second apparatus unit is connected via the connecting line to the crystallisation region of a first apparatus unit.
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15. Apparatus for polymerising (meth)acrylic acid, comprising an apparatus for producing (meth)acrylic acid according to any of claims 9 to 14 and a polymerisation unit, wherein the purification apparatus of the apparatus for producing (meth)acrylic acid is connected to the polymerisation unit.
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16. Process according to any one of claims 1 to 8, wherein the process is carried out in an apparatus according to any one of claims 10 to 14.
- 30 17. (Meth)acrylic acid obtainable by a process according to any of claims 1 to 8 or 16.

18. Process for producing a polymer based on (meth)acrylic acid, wherein a (meth)acrylic acid according to claim 17 is polymerised.
- 19.. Polymer, obtainable by a process according to claim 18.
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20. Fibres, shaped articles, films, foams, superabsorbent polymers, special polymers for the areas of waste water treatment, dispersion dyes, cosmetics, textiles, leather treatment or paper production or hygiene articles, at least based on or comprising (meth)acrylic acid according to claim 17 or a polymer according to claim 19.
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21. Use of the (meth)acrylic acid according to claim 17 or a polymer according to claim 19 in or for the production of fibres, shaped articles, films, foams, superabsorbent polymers or hygiene articles, detergents or special polymers for the areas of waste water treatment, dispersion dyes, cosmetics, textiles, leather treatment or paper production.
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